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The efficacy of refrigerator as a storage device for protecting cowpea seeds against the cowpea bruchid, *Callosobruchus maculatus* (Fab.) (Coleoptera: Bruchidae)

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ABSTRACT: The efficacy of the use of the refrigerator as a storage device for protecting cowpea seeds against the storage pest, *Callosobruchus maculatus* (F.) was investigated. Two separate sets of cowpea seeds infested with C. maculatus and placed in polythene bags were kept in the refrigerator at 7°C ± 1 and room temperature (28°C ± 2) respectively. The results revealed that 100% bruchid mortality was recorded after 7 days of storage in the refrigerator compared to 10% in samples kept at room temperature. The seeds were in good state after 6 months of storage, grain quality was not affected by this storage method within this period. Re-infestation was also prevented in refrigerated samples during storage. Cowpea seeds were also found to be viable after the storage period. These results demonstrate clearly that refrigerator storage of cowpea seeds has a considerable effect in protecting cowpeas against *C. maculatus*.

Key Words: Pest control; Refrigeration; Storage pests; Cowpea seeds; Cowpea bruchid; *Callosobruchus maculatus*.

Introduction

Food deficit in tropical countries is due in large part to post-harvest crop losses, particularly for leguminous crops such as cowpea (*Vigna unguiculata* (L.) Walp.). High loses in stored cowpea occur due to infestation by the notorious cowpea seed beetle, *Callosobruchus maculatus* (F), Bruchidae. This storage pest s a major constraint to the storage and preservation of cowpea seeds in the tropics and subtropics (Jackai and Daout, 1986; Nurdock et al., 1997). Damage to cowpea seeds in storage due to attack by this pest accounts for losses averaging 60 – 80% in tropical Africa. Damaged seeds are riddled with adult beetle exit holes and have reduced weight and poor viability (Ofuya and Dawodu, 2002).

Various control methods have been employed to protect cowpea seeds in storage. Synthetic insecticides such as methacrifos, pirimiphos-methyl and fenitrothion provide good control of this bruchid in stored cowpea (Golob et al., 1999). The use of plant products such as pepper, groundnut oil and neem extract have also been investigated and found useful by many workers (Ivbijaro, 1983; Compton, 1993; Oparacke, 1998; Umoetsok and Okokon, 1999; Golob et al., 1999; Ofuya and Dawodu, 2002). Other methods used by farmers, especially in Northern Nigeria, for storing cowpea seeds against this notorious pest includes the

use of jute bags, plastic bags and other materials like sand, ash, kerosene, local insect powder and battery cell (Ibrahim and Mohammed, 1999).

The deleterious effects and attendant environmental and health risks associated with the use of most of the methods mentioned above calls for other alternative methods. This necessitated the experimentation with the use of refrigerator as a possible storage method for protecting cowpea seeds against the cowpea storage pest.

The present study, therefore, evaluates the effectiveness of the refrigerator as a protective storage device for the control of cowpea bruchid, *Callosobruchus maculatus* (Fab.) infesting cowpea seeds.

Materials and Methods

Cowpea seeds infested by bruchids (*Callosobruchus maculatus* F.) from a local market in Benin City, Nigeria, was sieved to separate adult bruchids from the seeds and kept in a Kilner jar with lid for six days. After another sieving to remove any new bruchid, seeds were weighed and placed in polythene bags, all weighing 1 kg each. Fifty newly emerged bruchids were introduced into each of the bags. The experiment had ten treatments with two replications. Ten of the bags containing the seeds were placed inside a refrigerator with a fitted thermostat. The temperature was kept at $7^{o}C \pm 1$. Another set of ten bags which served as control were placed on a laboratory bench at room temperature ($28^{o}C \pm 2$).

Adult bruchid mortality, obtained by sieving out and counting all dead bruchids in each bag, was recorded at 24h interval for samples in the refrigerator. Bruchid population and mortality were similarly recorded from the control. Seed viability, after storage period, was tested by planting 500 undamaged grains from the two trials and the number of germinated seeds was recorded. A paired t-test was employed to analyse the resultant data. Means were compared using Least Significant Difference (LSD). Bruchid emergence was calculated as a percentage of the initial number used on each treatment.

Results

The results of the percentage mortality of cowpea bruchid, *Callosobruchus maculatus* on cowpea seeds kept in the refrigerator at $7^{o}C \pm 1$ and those kept at room temperature ($28^{o}C \pm 2$) are given in Table 1. The percentage mortality obtained in the two trials showed that mortality increased cumulatively in the samples kept in the refrigerator from 10% in the second day to 100% after seventy days in storage. Comparatively, no bruchid mortality was recorded in the samples kept at room temperature until the seventh day when 10% mortality occurred.

The percentage mortality of bruchids observed in the refrigerated samples is presented graphically in Fig. 1. The curve obtained reflects the progressive mortality from entry to the eighth day. Larval forms inside the seeds were also observed to be dead at the end of the period of refrigeration. The larvae failed to develop to the adult stage when the samples were later kept at room temperature.

Table 2 shows cowpea seed viability after 24 weeks of storage. There was no significant difference ($P < 0.05$) in germinability of seeds between the treatment and control. An average of 88% of the seeds kept in the refrigerator germinated while 92% germination was recorded in the seeds kept at room temperature.

Discussion

The results of this study showed that refrigerator storage protected cowpea seeds from *Callosobruchus maculatus* attack. Cowpea seeds had 100% protection as against 10% in the unprotected control. Adults of the beetle were rapidly killed, oviposition and subsequent adult emergence were also completely prevented. Mortality of bruchids could be due to adverse effect of low temperature which created an unfavourable condition resulting in lowering or stoppage of physiological processes in the insect.

Table 1: Average percent mortality of cowpea bruchid on cowpea seeds in refrigerator and room temperature.

Day	Refrigerator (7°C ± 1)			Room Temperature (28°C ± 2)		
	No. of seeds with bruchid	No. of seeds with dead bruchids	% Mortality	No. of seeds with bruchid	No. of seeds with dead bruchids	% Mortality
1.	50	50	0	50	50	0
2.	50	5	10	50	50	0
3.	50	15	30	50	50	0
4.	50	25	50	50	50	0
5.	50	40	80	50	50	0
6.	50	45	90	50	50	0
7.	50	47	95	50	5	10
8.	50	50	100	50	5	10

Table 2: Effect of refrigerator storage on cowpea seed viability after 24 weeks of storage,

Treatment	Mean number of grains tested	Mean number of grains germinated	Mean % grain germinated
Refrigerator stored grains	500	440	88
Control	500	460	92

Odeyemi and Daramola (2000) have shown that temperature plays an important role in the biology of insects primarily by lowering their physiological processes and reproductive activities. Declining temperatures slow down physiological processes until the animal is unable to adjust to further temperature decline. Below a certain temperature a number of species enter a state of semitorpor, move sluggishly and cease to feed. Death of beetles can occur because low temperature exceeds their tolerance limits.

Although chemicals have proved to be very effective in controlling bruchids, the growing concerns about the impact of chemicals on food safety and the environment resulting from the use of agrochemicals makes chemical control unattractive. The use of various plant products to protect cowpea seeds against pest damage during storage is increasingly becoming popular among tropical farmers (Compton et al., 1993). It has, however, been shown that the use of relatively low rates of application of many plant products will not completely protect stored cowpea from bruchid damage (Ofuya and Dawodu, 2002). Dike and Mbah (1992) have reported that some plant products, for example lemon grass, were only effective in protecting cowpea grains from bruchid attack up to eight weeks post treatment. In addition, a lot of health risks are associated with many of the methods applied by peasant farmers, especially in Nigeria (Ibrahim and Mohammed, 1999).

Refrigeration method of storing cowpea seeds could reduce or eliminate some of the above problems. This method appears to be a dependable alternative to other methods. It is effective, easy to use and devoid of health risks. Furthermore, the present study has shown that the seeds are in good state after six months of storage, the grains maintained their pre-stored quality after the storage period.

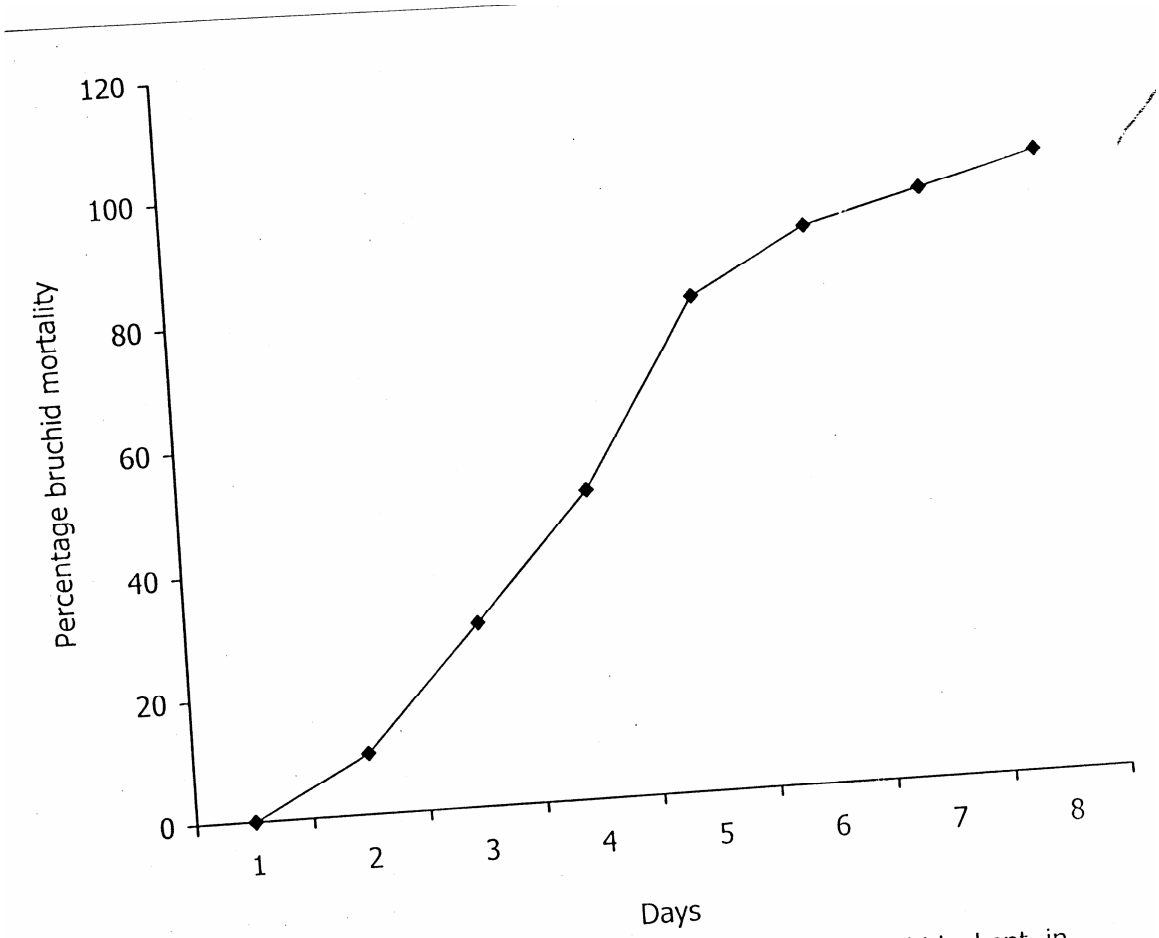

Figure 1. Graph showing percentage mortality of bruchids kept in refrigerator at 7° C ± 1.

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